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ABSTRACT

This study attempted to determine whether the mental test performance of 77 children tested at 6, 12, and 36 months of age could be predicted from scores on an Inventory of Home Stimulation used to assess the children's home environment during their infancy. The Inventory of Home Stimulation had six subscales: (1) emotional and verbal responsivity of the mother, (2) avoidance of restriction and punishment, (3) organization of the physical and temporal environment, (4) provision of appropriate play materials, (5) maternal involvement with the child, and (6) opportunities for variety in daily stimulation. This inventory was used to assess home environments when children were 6, 12 and 24 months of age. The Bayley Scales of Infant Development were used to measure mental performance when children were 6 and 12 months old; the Stanford-Binet scale was used when they were 36 months old. Correlations of the home inventory scores with Stanford-Binet scores were generally higher than those reported in an earlier study by McCall et al, which related infant tests and parental educational level to childhood IQ. It was concluded that the Inventory has the potential for use in the differential diagnosis of strengths and weaknesses in an infant's environment. (Author)

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THE RELATION OF INFANTS' HOME ENVIRONMENTS TO MENTAL TEST PERFORMANCE FROM 6 TO 36 MONTHS: A LONGITUDINAL ANALYSIS

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Several investigators (Bloom, 1964; Plowden, 1967; Walberg and Majoribanks, 1973) have produced evidence attesting to the fact that measures of various characteristics of the home environment contribute more strongly to the prediction of children's abilities than do social status or family structure indices. These studies have been cross-sectional in nature and have focused on children over ten years of age. Walberg and Majoribanks(1973), for example, interviewed the mothers and fathers of 185 eleven year-old boys with a home environment inventory based on the theorizing of Bloom (1964). They reported that their inventory contributed the most to the prediction of the boy's verbal and numerical abilities, when compared with SES and family structure measures via canonical correlation.

The present study involved the administration of a home environment inventory in infancy (The Inventory of Home Stimulation; Caldwell, Heider, and Kaplan, 1966) in order to explore its ability to predict later mental test performance.

Method

Subjects

The subjects for this analysis were 77 normal infants, representing part of a larger sample of 135 infants who participated in a longitudinal observation and intervention study (Caldwell, Elardo, and Elardo, 1972), which was designed to reveal the effects of different types of environments on infant development. In this larger investigation, infants and their home environments were studied from a time when children were six months of age until they were three years of age.

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PS 007 992

The present sample consists of 77 subjects from this larger study. Excluded from the larger sample were infants who received a program of educational intervention in the home and those for whom complete home environment and mental test data were not available. Additional descriptive information about the subjects is contained in Table 1.

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Insert Table 1 about here
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Instrumentation

A decade ago, a group of persons working on the Syracuse Early Learning Project (Caldwell and Richmond, 1968) began to devote considerable effort to the development of ways of assessing the subtle aspects of the young child's home environment in order to determine which specific features of it were most likely to influence development. The staff felt that it was imperative to develop a sensitive measure of the home environment which could warn of developmental risk before age three. Their long-term goal was to produce a valid, reliable, easy to administer, observationally based Inventory which would provide an index of the quality and quantity of social, emotional and cognitive support available to a young child (from birth to three years of age) within the home setting.

A survey of empirical data, developmental theory, and expert opinion was conducted for clues to home characteristics which are associated with favorable development during the early years of life. A list of environmental characteristics likely to foster early development in any setting was compiled and published (Caldwell, 1968), and an instrument named "The Inventory of Home Stimulation" was developed and standardized from this list. The current version of the Inventory contains 45 items representing the following six subscales: Emotional and Verbal Responsivity of the Mother, Avoidance of Restriction and Punishment, Organization of the Physical and Temporal Environment, Provision of Appropriate Play Materials, Maternal Involvement with the Child, and Opportunities for Variety in Daily Stimulation.

Scoring is based partly on observation and partly on answers to a semi-structured interview which is administered in the home at a time when the child is awake and can be observed in interaction with the mother or primary caregiver.

At an early stage of instrument development, consideration was given to the notion of including items based totally on observation of what transpired at the time of the visit, however, in order to cover certain important transactions not likely to occur during the visit, it was necessary to base about one-third of the items on parental report. All items are scored in a binary fashion (yes or no) and are phrased so that the total score equals the number of "yes" responses marked by the interviewer. The entire procedure takes approximately one hour.

At present extensive standardization data do not exist for the Inventory. Data have been gathered from 176 families in Central Arkansas, however; and these data indicate that the instrument is sensitive enough to register a wide range of scores for families with identical social status designations.

In terms of reliability, raters can quickly be trained to achieve a 90 percent level of agreement. Internal consistency (KR-20) coefficients based on 176 cases range from .44 for subscale No. 6 to .89 for subscale No. 3. The internal consistency coefficient for the total scale was computed at .89. Using data from assessments made at 6, 12, and 24 months on 91 families, test-retest correlations were computed for each subscale and the total scale. Results indicate that the Inventory has a moderate degree of stability across the 18-month period.

With regard to concurrent validity, Inventory of Home Stimulation scores for 91 families were correlated with seven socioeconomic-status variables (welfare status, maternal education, maternal occupation, presence of father in the home, paternal education, paternal occupation, and crowding in the home). Correlations between subscales and maternal education, presence of father in the home, paternal education, paternal occupation, and crowding were moderate (.25 to .55). Correlations between subscales and welfare status and maternal occupation were smaller in magnitude but still positive.

Procedure

Data collected from all subjects include scores on the Mental Development Index (MDI) of the Bayley Scales of Infant Development (Bayley, 1969) at six and twelve months of age, and scores on the Stanford-Binet scale at 36 months. Each infant's home environment was assessed at six, twelve, and twenty-four months with the Inventory of Home Stimulation.

Several analyses were performed to determine which aspect of the early home environment were associated with the infants' mental test performance.

Results

Table 2 shows the Pearson product-moment and multiple correlation coefficients between home environment scores at six months and Bayley MDI scores at six and twelve months and Stanford-Binet scores at 36 months. An examination of these coefficients

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indicates that subscale No. 3 (Organization of the Physical and Temporal Environment) and subscale No. 6 (Opportunities for Variety in Daily Stimulation) have the strongest relationship to MDI scores at six months ($r = .22$ and $r = .20$ respectively). These subscales have a stronger relationship to mental test performance than even the total score on the Inventory. The multiple correlation between all six subscales and the six-month MDI is listed at $r = .31$.

The same general pattern of coefficients obtains between six-month home environment scores and Bayley MDI scores at twelve months. To be specific, Opportunities for Variety in Daily Stimulation and Organization of the Physical and Temporal Environment are correlated with the criterion $r = .16$ and $r = .26$ respectively. The multiple correlation between all six scores and the 12-month MDI score is calculated at $r = .30$.

Correlations between six-month home environment scores and 36-month Binet scores are generally higher than correlations between six and twelve months, particularly the relationship between the total score and the 36-month Binet score ($r = .50$). In addition, Provision of Appropriate Play Materials ($r = .41$) and Maternal Involvement

with child (r = .33) seem about as strongly related with 36-month Binet performance as do Organization of the Physical and Temporal Environment (r = .40) and Opportunities for Variety in Daily Stimulation (r = .31). The multiple correlation is given at r = .54.

Pearson Product-Moment coefficients and multiple correlation coefficients between 12-month home environment scores and 12-month MDI scores and 36-month Binet scores are shown in Table 3. The 12-month MDI scores seem most strongly related to

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Provision of Appropriate Play Materials (r = .35). A moderate relationship is also observed for Organization of the Physical and Temporal Environment (r = .24) and Maternal Involvement with Child (r = .22). A multiple correlation of r = .40 was computed for all six subscales for this concurrent analysis.

Correlations ranging from r = .24 to r = .56 are observed between 12-month home environment scores and 36-month Binet scores, the highest being for Provision of Appropriate Play Materials (r = .56) and Maternal Involvement with Child (r = .47). It is at this level that Emotional and Verbal Responsivity also seems to show a strong relationship to mental test performance (r = .39). The correlation between 36-month Binet score and Total Home Environment score obtained at 12-months is listed at r = .55, while the multiple correlation between the six subscales of the Inventory of Home Stimulation and 36-month Binet scores is listed at r = .59.

In Table 4 the correlations between 24-month home environment scores and 36-month Binet scores are listed. Coefficients range from r = .41 for Avoidance of Restriction and Punishment to r = .64 for Provision of Appropriate Play Materials. The total home

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Insert Table 4 about here
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environment score at 24-months and the Binet score at 36-months share almost 50 percent common variance (r = .69). The multiple correlation between the six subscales and the 36-month Binet scores is computed at r = .72. Correlations between Bayley and Binet scores are presented in Table 5.

Discussion

We begin with a note of caution. The analyses presented in this paper are based on only 77 cases. Therefore, it would be presumptuous to assume that highly similar results would be obtained from a more representative group of families. More accurate information may also be obtained by analyzing males and females separately. Nevertheless, the results of our analyses suggest that those aspects of home environment assessed by the Inventory of Home Stimulation bear an important relationship to cognitive development during the first three years of life.

With our sample, the six home inventory subscale scores obtained at six-months of age yielded a multiple correlation of .54 with the same subjects' Binet at age three. The home scores obtained at 12 months yielded a multiple correlation of .59 with the Binet at age three; while the multiple correlation between 24-month home scores and Binet scores at age three was .72.

These correlations are quite high; in general they are higher than those reported in the McCall, Hogarty and Hurlburt (1972) analysis relating infant tests and parental education to childhood I.Q. They are also higher than Bayley-Binet correlations obtained from the same sample (see Table 5). The Inventory of Home Stimulation can thus be of value to those interested in the early identification of environmental factors detrimental to development. The work of Cravioto and DeLicardie (1972), which indicated that the presence of severe malnutrition was significantly associated with home stimulation, is illustrative of this: Cravioto and DeLicardie administered the Inventory of Home Stimulation twice yearly as part of their longitudinal investigation of environmental correlates of severe clinical malnutrition. From a sample of 229 infants, Cravioto and DeLicardie identified 19 infants who suffered from severe clinical malnutrition by the age of 39 months. From their total sample, they then assembled a matched control group for the malnourished infants and prpceeded to examine the distribution of scores on the Inventory of Home Stimulation for both groups. They found that the inventory which was administered at six months of age significantly

discriminated between infants who were to eventually become malnourished and non-malnourished, thus delineating an important relationship between children's social environments and their physiological state.

Also illustrative is the cross-sectional study of Wachs, Uzgiris, and Hunt (1971). They employed the Inventory of Home Stimulation in an investigation designed to relate the home background of infants to the infants' cognitive development, as measured by the Infant Psychological Development Scale (Uzgiris and Hunt, 1966). A total of 102 infants were involved in the study, ranging in age from 7 to 22 months. Two kinds of home circumstances were found to be most consistently related to infant development: intensity and variety of stimulation and opportunities to hear vocal labels for objects, actions, and relationships. The first factor was at several ages negatively correlated with developmental test performance, suggesting the harmful effects of overstimulation or 'stimulus bombardment.' The second factor, concerned with the infants' verbal environment in the home, revealed several significant positive relationships to development beginning as early as 15 months of age. Wachs, Uzgiris, and Hunt (1971) present a convincing argument that certain types of environmental stimulation may be related in a curvilinear rather than a linear manner to psychological development. Their explanation for this type of relationship rests in Hunt's concept (1961) of "Hypothesis of the Match." These researchers see a need for longitudinal research to provide more information for understanding the complex relationships between home circumstances and indices of psychological development.

Our results indicate that home environment, when measured at a time when the infant is approximately six months of age, does not relate in any important fashion to the infant's performance on the Bayley Mental Development Index at 6 or 12 months of age; whereas the correlation between home environment as measured at six months and Binet performance at three years appear to be both significant and important, as do the correlations between home environment measured at 12 and 24 months of age and 3-year Binet performance. These results suggest that the Inventory of Home Stimulation

is measuring a complex of environmental forces which are perhaps prerequisites to later performance on cognitive tasks, and is measuring those forces at a time in the infant's life prior to the period in development in which such environmental forces have affected the infant's measured development. During the first year of life the subscales "Organization of the Physical and Temporal Environment" and, to a lesser extent, "Opportunities for Variety in Daily Stimulation" seem most strongly related to mental test performance. However, beginning at twelve months, "Provision of Appropriate Play Materials" and "Maternal Involvement with Child" seem to show the strongest relationships. The meaning of these findings is uncertain. It may be that different aspects of home environment are most salient at certain times in development. It may, on the other hand, suggest that certain home environment factors interact with mental capabilities in a complex fashion.

The data obtained after twelve months of age seem to indicate that perhaps the most enriching environments experienced by the children in our sample may be characterized as those in which a mother (or some other primary caregiver) provided the infant with a variety of age-appropriate learning materials and who likewise consciously encouraged developmental advances by talking to, looking at and otherwise positively responding and attending to her child.

In this study, as in the case with other correlational studies, several different hypotheses may be considered as plausible explanations of the results obtained: (a) a stimulating environment produces a bright child, (b) a bright child causes those in the environment to react in a more stimulating fashion, (c) some third factor affects both the child and the child's environment, and (d) various types of children interact differently with certain types of environments. Experimental investigation, or perhaps cross-lagged correlational analysis or path analysis, must be conducted to determine which of the four is the most plausible for each of the home environment variables assessed by the Inventory.

For the present, for those who are of the opinion that the environmental forces assessed with the Inventory of Home Stimulation play primarily a causal role in development, the Inventory has the potential for use in the differential diagnosis of strengths and weaknesses present in an infant's environment -- thus assisting those concerned with prevention and remediation in their task of designing intervention strategies.

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TABLE 1

Characteristics of the Sample[1]

Family Data (N=77)

Welfare - 31, Non-welfare - 46
Father absent - 21, Father present - 56
Maternal Education (Avg. No. of yrs.) - 12.1
Paternal Education (Avg. No. of yrs.) - 12.9
Paternal Occupation (wide range of employment, but on the average about skilled labor to sales.)

Child Data

Black males: N = 29, $\overline{X}$DQ = 94.4, S. D. = 21.7
White males: N = 15, $\overline{X}$DQ = 104.1, S.D. = 10.7
Black females N = 21, $\overline{X}$DQ = 104.9, S. D. = 17.3
White females: N = 12, $\overline{X}$DQ = 102.6, S. D. = 22.6

[1] $\overline{X}$DQ in this table refers to the average score obtained by the infants when tested at six-months of age with the Mental Development Index of the Bayley Scales of Infant Development. (Bayley, 1969)

TABLE 2

Correlations between six-month Inventory of Home Stimulation scores and Mental Test Scores gathered at six, twelve, and thirty six months

HOME ENVIRONMENT VARIABLES	MENTAL TEST SCORES 6-month Bayley MDI	12-month Bayley MDI	36-month Binet
I. Emotional and Verbal Responsivity of Mother	-.008	.093	.254*
II. Avoidance of Restriction and Punishment	.005	.039	.244*
III. Organization of Physical and Temporal Environment	.224	.263	.402**
IV. Provision of Appropriate Play Materials	.146	.067	.408**
V. Maternal Involvement with Child	.061	- .003	.325**
VI. Opportunities for Variety in Daily Stimulation	.204	.158	.305**
Total Score	.141	.156	.500**
Multiple Correlation[1]	.313**	.301*	.537**

1 This represents the correlation of all subscores with mental test scores.

* $P < .05$
** $P < .01$

TABLE 3

Correlations between 12-month Inventory of Home Stimulation scores and Mental Test scores gathered at twelve and thirty-six months

HOME ENVIRONMENT VARIABLES	MENTAL TEST SCORES	
	12-month Bayley MDI	36-month Binet
I. Emotional and Verbal Responsivity of Mother	.176	.387**
II. Avoidance of Restriction and Punishment	- .008	.241*
III. Organization of Physical and Temporal Environment	.241	.389**
IV. Provision of Appropriate Play Materials	.353*	.561**
V. Maternal Involvement with Child	.218*	.468**
VI. Opportunities for Variety in Daily Stimulation	.054	.283*
Total Score	.252*	.551**
Multiple Correlation[1]	.400**	.588**

1 This represents the correlation of all subscales with mental test scores.

*P < .05
**P < .01

TABLE 4

Correlations between twenty-four month Inventory of Home Stimulation scores and Mental Test scores at thirty-six months

	Home Environment Variables	Mental Test Scores 36-month Binet
I.	Emotional and Verbal Responsivity of Mother	.495**
II.	Avoidance of Restriction and Punishment	.406**
III.	Organization of Physical and Temporal Environment	.413**
IV.	Provision of Appropriate Play Materials	.635**
V.	Maternal Involvement with Child	.545**
VI.	Opportunities for Variety in Daily Stimulation	.499**
	Total Score	.695**
	Multiple Correlation [1]	.718 **

[1] This represents the correlation of all subscales with mental test scores.

*p < .05
**p < .01

TABLE 5

Correlations between 6-month Bayley MDI, 12-month Bayley MDI, and 36-month Stanford-Binet scores

(N = 77)

Scales	MDI-12	IQ-36
MDI-6	.410**	.283*
MDI-12	--	.319**

*P < .05
**P < .01

Abstract

In contrast to the large array of instruments available for the measurement of individual differences in children, there have been almost no techniques available to permit the precise measurement of the child's home learning environment. The present study involved the administration of a home environment inventory to a sample of 77 mothers and infants. Home inventory data was then correlated with infant development over a period of thirty months. Obtained correlations were in general higher than those typically reported relating infant tests or parental education level to childhood IQ, thus demonstrating the utility of the home environment inventory.

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